Online Resource 1

Supplementary Information

Article title

Forest management history, habitat heterogeneity, and landscape context shape parasitoid wasp (Ichneumonoidea) abundance in boreal spruce forests

Journal

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Appendix S1

Total abundance of all Ichneumonidae and Braconidae subfamilies in both forest management types combined. "Generalist" = idiobiont; "Specialist" = koinobiont. An "X" indicates the life-history strategy for each subfamily. Subfamilies lacking an "X" in both the "Generalist" and "Specialist" columns can exhibit both strategies. Subfamilies without an "X" in "Saproxylic" are considered non-saproxylic. There were 27 individuals across three subfamilies that could not be assigned to generalist or specialist due to unknown life history. Sources listed as "cited in" were not consulted directly but are included for completeness and traceability of life-history information.

Subfamily	Generalist	Specialist	Saproxylic	Abundance	Sources
Adelognathinae				1	Broad et al. (2018); Quicke (2015)
Alysiinae		X		116	Chen and van Achterberg (2019); Jasso-Martínez et al. (2022b); Quicke (2015); Shaw and Huddleston (1991)
Anomaloninae		X		42	Broad et al. (2018); Quicke (2015)
Aphidiinae		X		35	Chen and van Achterberg (2019); Jasso-Martínez et al. (2022b); Quicke (2015); Shaw and Huddleston (1991)
Banchinae		X		19	Broad et al. (2018); Quicke (2015)
Brachistinae		X	X	17	Aubrook (1939) cited in Shaw and Huddleston (1991); Chen and van Achterberg (2019); Hilszczański (2018); Jasso-Martínez et al. (2022b); Kenis and Mills (1998); Sharanowski et al. (2011); Shaw and Huddleston (1991)
Braconinae	X		X	4	Chen and van Achterberg (2019); Hilszczański (2018); Jasso-Martínez et al. (2022b); Quicke (2015); Shaw and Huddleston (1991)
Campopleginae		X	X	125	Broad et al. (2018); Hilszczański (2018); Luo and Sheng (2010); Quicke (2015)
Charmontinae		X		4	Chen and van Achterberg (2019); Jasso-Martínez et al. (2022b); Quicke (2015); Shaw and Huddleston (1991)
Cheloninae		X		7	Chen and van Achterberg (2019); Jasso-Martínez et al. (2022b); Kittel et al. (2016); Quicke (2015); Shaw and Huddleston (1991)

Cryptinae	X		X	295	Broad et al. (2018); Hilszczański (2018); Quicke (2015)
Ctenopelmatinae		X		62	Broad et al. (2018); Kasparyan and Kopelke (2010); Quicke (2015)
Diplazontinae		X		4	Broad et al. (2018); Quicke (2015); Wahl (1990)
Doryctinae	X		X	4	Chen and van Achterberg (2019); Hilszczański (2018); Jasso-Martínez et al. (2022b); Quicke (2015); Shaw and Huddleston (1991)
Euphorinae		X	X	142	Ammunét et al. (2009); Chen and van Achterberg (2019); Hilszczański (2018); Huddleston (1980); Jasso-Martínez et al. (2022b); Quicke (2015); Shaw and Huddleston (1991); Shaw (2004); Stigenberg and Hansen (2013)
Helconinae		X	X	1	Chen and van Achterberg (2019); Hilszczański (2018); Jasso-Martínez et al. (2022b); Kenis and Hilszczanski (2004); Quicke (2015); Sharanowski et al. (2011); Shaw and Huddleston (1991)
Hormiinae	X			1	Jasso-Martínez et al. (2022b); Jasso-Martínez et al. (2021); Quicke (2015); Shaw and Huddleston (1991)
Hybrizontinae		X		1	Broad et al. (2018); Quicke (2015)
Ichneumoninae				139	Broad et al. (2018); Godfray (1994); Hinz and Horstmann (2007) cited in Broad et al. (2018); Perkins (1960); Quicke (2015); Shaw et al. (2015)
Ichneutinae		X		3	Jasso-Martínez et al. (2022b); Quicke (2015); Shaw and Huddleston (1991)
Mesochorinae		X		16	Broad et al. (2018); Quicke (2015)
Metopiinae		X		12	Broad et al. (2018); Quicke (2015)
Microgastrinae		X		50	Jasso-Martínez et al. (2022b); Quicke (2015); Shaw and Huddleston (1991); Whitfield et al. (2018)

Ophioninae		X		5	Broad et al. (2018); Quicke (2015)
Opiinae		X		3	Chen and van Achterberg (2019); Jasso-Martínez et al. (2022b); Quicke (2015); Shaw and Huddleston (1991)
Orthocentrinae		X		222	Broad et al. (2018); Kolarov and Bechev (1995); Komonen et al. (2000); Quicke (2015); Roman (1939), Šedivý and Ševčík (2003), Shaw and Askew (2010), and Short (1978) cited in Broad et al. (2018); Vilkamaa and Komonen (2001); Wahl (1990); Wahl (1986); Wahl (1996); Waterston (1929) cited in Broad et al. (2018)
Phygadeuontinae	X			323	Broad et al. (2018); Santos (2017); Schwarz and Shaw (1999), and Schwarz and Shaw (2010) cited in Broad et al. (2018)
Pimplinae			X	60	Broad et al. (2018); Eberhard (2000); Fitton et al. (1988); Gauld and Dubois (2006); Gauld et al. (2002); Hilszczański (2018); Korenko et al. (2022); Matsumoto (2016); Quicke (2015); Quicke et al. (2009); Shaw (2006); Wahl and Gauld (1998); Weng and Barrantes (2007)
Poemeniinae	X		X	1	Broad et al. (2018); Fitton et al. (1988); Gauld et al. (2002); Hilszczański (2018); Quicke (2015); Quicke et al. (2009); Shaw (2006); Wahl and Gauld (1998)
Rhyssinae	X		X	3	Broad et al. (2018); Fitton et al. (1988); Gauld et al. (2002); Hanson (1939); Hilszczański (2018); Madden (1968); Quicke (2015); Quicke et al. (2009); Shaw (2006); Spradbery (1970a); Spradbery (1970b); Wahl and Gauld (1998)
Rogadinae		X		3	Jasso-Martínez et al. (2022b); Jasso-Martínez et al. (2021); Quicke (2015); Shaw and Huddleston (1991)

Telengaiinae (previously Gnamptodontinae)	X (?)			1	The subfamily Telengaiinae (previously Gnamptodontinae) follows the classification in Jasso-Martínez et al. (2022b). The name change is also noted in Jasso-Martínez et al. (2022a). Earlier sources using Gnamptodontinae—Belshaw et al. (2003); Chen and van Achterberg (2019); Quicke (2015); Shaw and Huddleston (1991) —are outdated in terms of nomenclature but provide useful background information.
Tersilochinae		X		22	Broad et al. (2018); Quicke (2015); Quicke et al. (2009)
Tryphoninae		X		138	Broad et al. (2018); Kasparyan (1990); Quicke (2015)
Xoridinae	X		X	9	Broad et al. (2018); Chrystal and Skinner (1931); Gauld and Fitton (1981) cited in Broad et al. (2018); Hilszczański (2018); Johansson (2020); Johansson (2022); Quicke (2015); Spradbery (1970b)

Appendix S2

Response variables used in the analyses. The distributions shown correspond to the best-supported models selected using AIC and may differ from those of the forest-type models due to differences in model structure.

Category	Response variable	Distribution
Family	Ichneumonidae	Negative binomial
Family	Braconidae	Negative binomial
Subfamily	Phygadeuontinae	Negative binomial
Subfamily	Cryptinae	Negative binomial
Subfamily	Orthocentrinae	Poisson
Subfamily	Euphorinae	Poisson
Subfamily	Ichneumoninae	Negative binomial
Subfamily	Tryphoninae	Poisson
Subfamily	Campopleginae	Poisson
Subfamily	Alysiinae	Negative binomial
Functional Group	Generalist Ichneumonoidea	Negative binomial
Functional Group	Specialist Ichneumonoidea	Poisson
Functional Group	Saproxylic Ichneumonoidea	Negative binomial

Appendix S3

Variable pairs with |r| > 0.5 (moderate to strong correlations). All continuous predictors were standardized using the `scale()` function (denoted "std").

Variable 1	Variable 2	Correlation coefficient	Method
Connectivity (0.5km std)	Dead wood volume (std)	0.56	Pearson
Connectivity (0.5km std)	Dead wood diversity (std)	0.57	Pearson
Connectivity (0.5km std)	Connectivity (20km std)	0.62	Pearson
Dead wood volume (std)	Dead wood diversity (std)	0.80	Pearson
Mean temperature (std)	Connectivity (20km std)	-0.74	Pearson
Mean temperature (std)	Mean precipitation (std)	-0.58	Pearson
Connectivity (0.5km std)	Dead wood volume (std)	0.66	Spearman
Connectivity (0.5km std)	Dead wood diversity (std)	0.61	Spearman
Connectivity (0.5km std)	Connectivity (20km std)	0.63	Spearman
Dead wood volume (std)	Dead wood diversity (std)	0.82	Spearman
Mean temperature (std)	Connectivity (20km std)	-0.71	Spearman
Mean temperature (std)	Mean precipitation (std)	-0.58	Spearman

Appendix S4

Summary of candidate model structures and included predictors used for model selection. All continuous predictors (dead wood volume, dead wood diversity, mean temperature, mean precipitation, local connectivity at 0.5 km, and regional connectivity at 20 km) were standardized using the `scale()` function. All models included Site_ID (sampling site) as a random effect.

Model name	Predictors included
Null model	Year
Forest type	Forest type + Year
Local 1	Forest type + Local connectivity (0.5 km) + Year
Local 2	Forest type + Dead wood diversity + Year
Local 3	Forest type + Dead wood volume + Year
Regional 1	Forest type + Mean precipitation + Year
Regional 2	Forest type + Mean temperature + Year
Regional 3	Forest type + Regional connectivity (20 km) + Year
Regional 4	Forest type + Mean precipitation + Regional connectivity (20 km) + Year
Full 1	Forest type + Local connectivity (0.5 km) + Mean precipitation + Year
Full 2	Forest type + Local connectivity (0.5 km) + Mean temperature + Year
Full 3	Forest type + Dead wood volume + Mean temperature + Year
Full 4	Forest type + Dead wood volume + Mean precipitation + Regional connectivity (20 km) + Year
Full 5	Forest type + Dead wood diversity + Mean temperature + Year
Full 6	Forest type + Dead wood diversity + Mean precipitation + Regional connectivity (20 km) + Year

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